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responsible for the vascular plants, giving rise directly and independently to three groups ("Filicineae, Lycopodineae, Equisetineae"), the first of which gives rise to the cycadophytes, while the lycopods produce the conifers and these in turn are responsible for the gnetums and the angiosperms. To the modern student of phylogeny this scheme is more interesting than appealing.—J. M. C.

Arm-chair science.—Sir RAY LANKESTER has brought together in book form a group of papers which he contributed to a London daily paper,[11] and which were addressed, of course, to the general public. It is a good illustration of the attitude of the man of science in England, as contrasted with the attitude of his colleagues in the United States. He wishes the public to know of the achievements of science, and this same spirit makes of the British Association a body of great popular interest. Of course "science from an easy chair" is not exact science, for it talks about subjects in an entertaining and suggestive way rather than about demonstrated facts. But still it is a fair question whether the arousing of interest in this way is not justified by the results.

It is of interest to note a zoologist's selection of botanical topics for such presentation. It is as follows: "A rival of the fabled upas tree" (which turns out to be *Rhus Toxicodendron*), "Poisons and stings of plants and animals," "The simplest living things," "The origin of opium," besides general biological topics that pertain to both animals and plants.—J. M. C.

NOTES FOR STUDENTS

Anatomy of Osmundaceae.—GWYNNE-VAUGHAN[12] has found the course of development of the stele in *Osmunda regalis*, *O. palustris*, and a species of *Todea* to correspond very closely to that already described for *Osmunda cinnamomea*. While the details in different individuals are variable, in general it may be said of all that the juvenile stage is long drawn out, and that at least the first pith formed is "stelar," that is, of intrastelar origin. The nodal pockets or parenchymatous pits in the medullary rays, characteristic of the Osmundaceae, are regarded as rather primitive organs and as having arisen independently of the pith. Perhaps the most interesting observation is the fact that some of the earlier leaf traces in *O. regalis* are mesarch. The main part of the paper is devoted to a discussion of the nature of the pith in the Osmundaceae. The author rightly hesitates to draw any far-reaching phylogenetic deductions from the phenomena observed in the sporeling, but prefers to rest his case, in favor of the view that the osmundaceous pith is stelar, on the fossils described by KIDSTON and GWYNNE-VAUGHAN. These fossils include protostelic ferns, in some of which the central tracheids are shorter than the outer ones, and siphonostelic ferns in which the medullary rays are narrow or lacking. These feature forms are interpreted as an evolutionary series in which the outstanding is the development of a stelar pith by means of a reduction of the central tracheids and their replacement finally by parenchyma. It would be difficult to prove or disprove this view. That a stelar pith might originate in this way or by an expansion of the stele, as in the roots of many of the higher plants, is unquestioned. But that these fossils represented evolutionary stages which culminated in the conversion of a part of a stelar pith into phloem and endodermis, as in *Osmundites skidegatensis* or *Osmunda cinnamomea*, is unsupported by evidence of any kind.

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[11] LANKESTER, SIR RAY, Science from an easy chair. 8vo. pp. xiii+423. *pls. 2. figs. 82.* New York: Macmillan. 1911. $1.75.

[12] GWYNNE-VAUGHAN, D. T., Some remarks on the anatomy of the Osmundaceae. Ann. Botany **25**:525–536. *pl. 44. figs. 5.* 1911.

GWYNNE-VAUGHAN and BOWER accept JEFFREY'S hypothesis as to the extrastelar character of the pith in every other family of ferns, but in dealing with the Osmundaceae they cloud the issue by apparently confusing two problems. From a limited series of imperfect fossils they have tried to discover when and how cortical tissues might have been enclosed by the stele. Failing in this, they conclude that they probably could not have been included at all. But neither are we sure when and how that happened in the other families, and a search through the known fossil representatives would probably end as unsatisfactorily as in the case of the Osmundaceae. Research so far has been successful mainly in verifying the theory that the filicinean pith is extrastelar, and with such forms as *Onoclea*, in which the pith consists partly of epidermal tissues and the atmosphere, there is scarcely any escape from accepting it, just as these botanists have done. It is true that the evidence in *Osmunda* is not as striking as in *Onoclea*, but it is quite as striking as in many other forms with extrastelar piths. There are representatives of the Osmundaceae in which the central pith, peripheral pith, internal endodermis, and internal phloem are texturally like those of the outer cortex, inner cortex, external endodermis, and external phloem, and these respectively are continuous at times through leaf or branch gaps. Moreover, there are abundant instances of what in other groups would readily be conceded vestiges of portions of amphiphloic siphonosteles. Applying the same standards of interpretation of anatomical phenomena to all the Filicales, it seems reasonable to maintain that the kind of evidence that has carried conviction in every case but one must hold in all. The question as to when and how the extrastelar pith originated is quite another matter, and I venture to affirm that observations on such features as the relative position of a tracheid and a parenchyma cell in the xylem of a sporeling, or the shape of medullary rays in an adult, will help little in its solution.—J. H. FAULL.

Biology of lichens.—In his culture studies TOBLER[13] used *Cladonia glauca* Floerke and *C. squamosa* (Scop.) Hoffm. By carefully scraping the branches, clusters of soredia were separated. These were sown on sterile

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[13] TOBLER, F., Zur Biologie von Flechten und Flechtenpilzen. II. Die Entwicklung der Cladonia-Soredien. Jahrb. Wiss. Bot. **49**:409–417. *pl. 3. figs. 11.* 1911.